THURSDAY, DECEMBER 18, 1890.

SHAKING THE FOUNDATIONS OF SCIENCE.

DURING the past twenty years there has been gathered together round the site of the 1862 International Exhibition a national collection of museums and schools for instructing the people in art, natural history, and in pure and applied science. For a time a senseless howl was raised that the whole thing was a mighty job to benefit a few, and the antagonism reached its climax when it was proposed to celebrate the year of the Queen's Jubilee by erecting the Imperial Institute on the "inaccessible" spot at which so many millions from all parts of London—nay, from all parts of Great Britain—had congregated to study fishes and food, microbes and music, inventions and instantaneous illuminations, the colonies and coloured fountains.

At length the more sensible of the critics began to realize that the supposed sinecurists at South Kensington were enthusiastic workers who, had they devoted their intellectual powers to the common occupation of enlarging their balance at the bankers instead of to the uncommon occupation of enlarging our knowledge of Nature, would have become capitalists whose vested interests would have been deemed more sacred than life or honour. As it is, the hosts of Mammon now threaten the domain of science in Exhibition Road, for it is actually proposed to make an underground railway, with trains running at frequent intervals, right under Prof. Rücker's laboratory, right under Prof. Norman Lockyer's observatory, and skirting the electrical research laboratories of the City and Guilds Technical College, called the Central Institution.

The English nation (for what concerns the development of our science concerns the nation at large) must abandon its oft-boasted claim of being a practical people. Germany will laugh us to scorn, France will hit us with an epigram, and Italy will view us with polite amazement. To the Royal College of Science come from all parts of our country science teachers to be taught; to the Central Institution come, in addition to English lads, graduates from colleges in Europe and America to learn how England teaches the application of science to industry. Shall they come to find a rumbling earthquake led from early morn to late at night close to the foundations of the very pillars that have been erected at considerable cost in order to secure for the instruments placed on them freedom from even the vibration caused by passing footsteps? On concrete foundations, some 13 feet below the level of the street, rest many pillars of 9 feet square, each quite separate from its neighbour and from the floor on which the students stand; and the upper portion of each pillar is stuffed with a thick cushion of wool, so that the instrument resting on it may give as unwavering a decision as does the Lord Chancellor on the woolsack.

And even this is not sufficient to secure all the quiet that Urania loves, for, just as earthquakes are foretold by the fluttering of the wings of birds, so the approach of a cart at the other end of Exhibition Road is foreshadowed, long before it can be heard, by the uneasy trembling of the very delicate galvanometer needles. Hence must Urania's attendants, the students engaged in research, worship at her shrine by night; and woe betide them if they happen to assemble when a "small and early" is held in Exhibition Road; for then must they cover their heads and mournfully depart, persecuted by the rolling brougham, heartbroken by the rumbling growler, and driven to despair by the rattling hansom. Even at the Cavendish Laboratory, in a quiet back street in the peaceful University town of Cambridge, Lord Rayleigh's most accurate work on the electric units had to be done at night; and Wheatstone's galvanometer magnetic needles at King's College followed the penny iron steamers during the day rather than the electric currents he was measuring.

Judge, then, what will be the effect of passing trains, even though they be drawn by no

> "Kittle of steäm,
> Huzzin' and maäzin' the blessed ground with the Divil's oän teäm,"

on the telescopes in Exhibition Road, which, besides other work, by long-exposure photographs have discovered for us new stars never yet seen in telescope by human eye; or on the galvanometers, whose ray of light aids all electrical industries by pointing out electric flaws in glass and porcelain which the microscope would mistakenly pronounce perfect.

England has just given the Rumford Medal to Prof. Hertz, of Bonn, for his splendid work on electro-magnetic radiation. Will England allow the short-sighted policy of Mammon—

> "Mammon the least erected spirit that fell from heaven"—

to prevent Prof. Boys continuing his work on the same subject at South Kensington? We honour Cavendish for weighing the earth: and now, when Boys has discovered how to hang bodies (not human) by quartz fibres, and so to weigh the earth with far greater accuracy than Cavendish could have done had his attracting balls been the size of houses, shall Boys be prevented from using his own apparatus? Shall the analysis of alternate-current waves at the Central Institution be interfered with by other waves set up by the new burrowing earthworm? We can hardly think so, when we remember how even a dear old soul has just received the news that an underground railway is to run close against our national science schools and laboratories. She, like Huxley's chum Gallio, cares for none of these things, but she had the sense to observe promptly, "Why, it will make all the things wriggle inside."

To study one set of vibrations in the laboratories in Exhibition Road, when another disturbing set is superimposed by the vibration of the building itself, will be like listening to a violin solo when a brass band is braying in the neighbourhood. A prince, the Duke of Edinburgh, renowned for his musical skill, and distinguished as a violin-player at the Albert Hall close by, might fitly take the lead in jealously preserving the possibility for scientific research, the importance of which his father would have been the first to recognize. Urania's voice is like Cordelia's, "ever soft, gentle, and low," and catch it the student never can if his beams of light when moving across his galvanometer and electrometer scales begin

> "To trip it as they go
> On the light fantastic toe."

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Radio-micrometers magnetometers, and every other meter the motion of whose index must be greatly magnified, will become simply museum specimens, illustrating the blindly commercial enterprise of Englishmen, who removed from Trafalgar Square the statue of Jenner, because he only showed us how to save countless lives in every country, and was not distinguished, like the people whose statues remain, by killing many to add to England's landed estate. The 3-foot telescope now being erected in Exhibition Road, will, of course, become useless when the earth-shaking train goes whirling underneath it. Why not leave it at once, like a broken monumental column, to mark the spot where lies buried many a noble hope?

But those who know, from past experience, how "great effects from little causes spring," already ask whether the scientific education of many, and the carrying on of scientific researches, such as have already been conducted in the laboratories in Exhibition Road, may not be worth more to the nation than any number of twopenny-ha'penny railway fares.

And others, whose only claim to be heard is the possession of that rarest of all senses—common sense—ask, Can it be possible that the nation, after having spent such vast sums on the erection and equipment of these laboratories, will now permit them to be rendered well nigh useless?

To move the laboratories of applied science is as undesirable as it is now impossible. Lord Carlingford, at their opening, congratulated the nation that a site had been selected for them close to the Museums, and stated that the French had even just moved the École Centrale of Paris, so that it might be placed in close proximity to the Conservatoire des Arts et Métiers. It is not likely that we shall now reverse our policy, divorce our Schools from our Museums, and, in securing such a result, waste all that has already been spent. If a railway is needed between South Kensington and Tyburnia, let it go under Queen's Gate, and not "Round by the Serpentine under the trees," as sung Lord Algernon. The Muse utters a cry of distress, let us join with her in shouting—

> "Procul, oh! procul, este profani."

THE PALÆOZOIC FISHES OF NORTH AMERICA.

The Palæozoic Fishes of North America. By John Strong Newberry. (Monograph of the United States Geological Survey, No. XVI., dated 1889, issued August 1890.) Pp. 228, Pls. liii. (Washington: Government Printing Office.)

NEARLY all of importance that has hitherto been written concerning the Palæozoic fishes of the United States has proceeded from the pen of Prof. J. S. Newberry, of Columbia College, New York, whose numerous contributions during the last thirty years are to be found both in the American journals and periodicals, and in the beautifully illustrated volumes of a few of the State Surveys. Some of these contributions form extensive memoirs and are accompanied by numerous figures; but many are scattered notices without adequate illustration, relating to subjects worthy of much more elaborate treatment. The newly organized United States Geological Survey thus did good service to palæichthyology when it undertook, some time ago, to publish an extended monograph summarizing the whole of Dr. Newberry's researches and bringing them up to date. The result of the undertaking is the fine quarto volume now before us, which not only deals with forms already described, but also makes known a large amount of valuable new material, which the author has assiduously collected from various sources, and, for the most part, added to the unique collection in the Columbia College Museum.

The monograph occupies 228 pages, printed in the Survey's usual excellent style; and there are 53 plates, of which, unfortunately, little complimentary can be said. Eight of the latter are inferior process-reproductions of plates that have already appeared elsewhere, and many of the others are so carelessly produced by the same photographic method, that they give a very imperfect idea of the fossils they are supposed to represent.

Dr. Newberry treats the subject in stratigraphical order, and deals almost exclusively with the fishes of the Devonian and Carboniferous periods. Two pages only are devoted to the recent discovery of Upper Silurian fishes by Prof. Claypole; and no reference whatever is made to the few interesting Palæozoic types briefly described some years ago by Prof. Cope, from the Permian of Texas. The information concerning Devonian and Carboniferous genera, however, is most copious, accompanied by numerous references to literature; and we can only regret that the author did not continue his researches further into taxonomy, thus arranging the forms of each great period in some definite zoological order.

The limits of the Devonian age adopted by Dr. Newberry are somewhat different from those accepted by most American authors, and we doubt whether the inclusion of the Chemung and Catskill groups in the Carboniferous series will be generally accepted by either American or European geologists. The fish-fauna of each of these groups is certainly not Carboniferous, as ordinarily understood. Dr. Newberry considers that the Devonian series in the United States consists of the Oriskany (Lower), Corniferous (Middle), and Hamilton (Upper) groups; and the only fish-remains worthy of description are those from the two latter horizons. The account of the Corniferous fishes occupies 24 pages, and comprises little that is new, being almost exclusively a verbatim reprint from the Ohio Survey Reports of 1873 and 1875. A plate, illustrating several of the bones of the problematical Ganoid *Onychodus*, is the most important addition; and the remarks on the armoured fish *Macropetalichthys* constitute the most serious error that modern researches ought by this time to have eradicated. The fishes of the Hamilton group include more novelties, among which may be specially noted the triturating dental pavement apparently of an Elasmobranch (*Goniodus*), in addition to a new type of ribbed Ichthyodorulite (*Heteracanthus*), resembling in shape the well-known Carboniferous *Physonemus*.

The Chemung, Catskill, and Waverly groups constitute the Lower Carboniferous in Dr. Newberry's classification; and the series of limestones that contain the same fish-fauna as the lowest beds of the British Mountain Lime-

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